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Limnological study of a fresh water pond, Nashik District (MS), India

Tidame SK☼**, Thakare CV**

Dept. of Zoology, K.T.H.M. College, Nashik- 422 003, (MS) India

☼**Correspondence to:** Dept. of Zoology, K.T.H.M. College, Nashik- 422 003, (MS) India; Email:- savita.tidame@gmail.com

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ABSTRACT

Present work focused on the seasonal variation in the physico-chemical parameters of the fresh water pond- Prayagtirth, located at Trimbakeshwar in Nashik district, for two consecutive years 2010-2011 and 2011-2012. A total of 15 parameters were analysed and seasonal variation in values of two years is discussed. The data is represented as seasonal mean ± S.D. with coefficient of variation. Correlation matrix of various physico-chemical parameters was also computed and analyzed. High values of physico-chemical parameters were noticed due to the entry of agricultural run off and occasional flow of sewage into the pond. In addition dense algal growth was noticed which is caused by surge of nutrients whenever there was a rainfall.

Keywords: Physico -chemical parameters, Nashik, Pond, Correlation.

Abbreviations: S.D.- standard deviations, CV- coefficient of variations, BOD- biochemical oxygen demand, NPP & GPP- net & gross primary productivity.

1. INTRODUCTION

India is a unique country with great cultural diversity associated with all kinds of climates, rich flora and fauna. In spite of enormous volume of hydrosphere only a small portion of it is actually available as resource. More than 97% occurs in the form of sea, whose salinity makes it useless, while fresh water makes up only 2.6% (Imtiyaz Tali, et al., 2012). Water is one of the abundantly available substances in nature, which man has exploited more than any resources for the sustenance of life. Water of good quality is required for living organisms. Water quality provides current information about the concentration of various solutes at a given place and time. Water quality parameters provide the basis for judging the suitability of water for its designated uses and to improve existing conditions (Shinde, et al., 2011). For optimum development and management for the beneficial uses, current information is needed which is provided by water quality programmers (Lloyd, 1992). Unequal distribution of water on the surface of the earth and fast declining availability of usable fresh water are the major concerns in terms of water quantity and quality. Studies on comparison of patterns of seasonal variation in physico-chemical parameters for two consecutive calendar years might reveal whether changes are seasonal fluctuations or due to other factors. The present study is an attempt to assess the water quality of ponds in a rural area of Nashik district so that they may be sustainably exploited for multiple uses like rural water supply, fisheries and even recreation.

2. MATERIALS & METHODS

For the study of physico-chemical analysis water samples were collected fortnightly from the pond surface in a clean polythin container for the period of one year, February 2010 to January 2012. Water samples were collected during morning hours in between 8.00 to 10.00 a.m. in one liter containers from the three sites of the pond. Some of the results were recorded at the sampling sites whereas the others were recorded in the laboratory. The parameters observed were pH, hardness, calcium, magnesium, turbidity, sulphate, phosphate, DO, free CO_2, acidity, alkalinity, chloride, gross and net primary productivity and BOD. The various physico-chemical parameters were analysed by following the standard methods of Trivedy and Goel (1984), APHA (1995). Primary productivity was measured using dark and light bottle method and turbidity was measured by Secchi Disc method.

3. STUDY AREA (Prayagtirth Pond)

It is situated one kilometer away from Trimbakeshwar city, which is 24 km away from Nashik district. This pond is stagnant, perennial and hexagonal in shape. It measures about 1.5 acre, 20 meter deep and well-constructed. The pond serves as water reservoir for agriculture, washing cloths and for drinking and washing domestic animals.

4. RESULTS & DISCUSSION

The quantitative analysis of various physico-chemical parameters is presented in Table I. The water temperature varied with variation of season as lowest in winter and highest in monsoon (Lashari et. al., 2009, Tidame and Shinde 2012). No such significant difference is observed in temperature during two years of investigation. The lowest pH value was found during winter due to dilution effect (Shiddamallayya and Pratima 2008, Agarkar and Garode 2001). The alkaline pH was recorded throughout the year (Mali and Gajaria 2004) but during second year pH was found to be increased. Dissolved oxygen was recorded minimum in winter (Venkatesharaju et. al., 2010) and highest in monsoon, whereas during second year of study low dissolved oxygen was recorded during summer season may be due to increased decomposition and increased respiration. The lowest amount of free carbon-dioxide is recorded in monsoon and highest in summer (Raj Narayan et. al., 2007) may be due to increased respiration. The Secchi disc transparency (turbidity) shows that water is more turbid in monsoon and least turbid in winter (Kedar et. al., 2008). Hardness measures highest in slightly high concentration recorded. The increase in hardness can be attributed to the decrease in water volume and increase in the rate of evaporation at high temperature. The highest value of calcium was recorded in summer and low during monsoon for two consecutive years. The maximum concentration of magnesium was recorded in summer and minimum in monsoon (Table 1).

Net primary productivity was noticed maximum in summer and minimum in winter during consecutive years 2010-2012. Gross primary productivity was found maximum in monsoon and minimum in winter (Tidame & Shinde, 2012). The minimum BOD was noticed during the postmonsoon due to decrease in temperature which leads to decrease in microbial activity and algal blooms (Sachidanandamurthy and Yajurvedi 2004, Shiddamallayya and Pratima, 2008). The highest BOD was recorded during summer (Sachidanandamurthy and Yajurvedi 2006, Shinde et. al., 2011). BOD was found to be increased during consecutive years. The lowest concentration of chloride was observed in monsoon, (Shiddamallayya and Pratima 2008, Venkatesharaju et. al., 2010) and highest in summer.

The lowest alkalinity was observed during winter (Shiddamallayya and Pratima, 2008) and highest during summer due to the decomposition of organic matter in water body, but during second year the alkalinity showed different pattern that is low in monsoon may be due to change in rainfall. During two years of investigation the increased alkalinity concentration was recorded at

Prayagtirth pond. The lowest concentration of phosphate was assessed during winter and highest during monsoon (Shinde et. al. 2010) might be due to rain water came from agricultural fields and mixed with the influent water of the reservoir, but during second year low phosphate concentration was recorded during summer may be due to utilization of phoshate by plants. The highest content of sulphate was recorded during summer (Agarkar and Garode, 2000, Shinde et al., 2010) and low during winter for two years of investigation.

Table 1

Seasonal variation (Mean ± S.D. (CV) in physico-chemical properties of water for the years 2010-2011 and 2011-2012

Parameters	Summer 2010-11	Monsoon 2010-11	Winter 2010-11	Summer 2011-12	Monsoon 2011-12	Winter 2011-12
pH	8.84±0.33(3.8)	8.72±0.49(5.6)	8.49±0.19(2.25)	9.05±0.66(7.3)	9.28±0.18(1.94)	8.78±0.21(2.36)
Temperature	21.83±4.5(20.7)	25.52±1.36(5.3)	20.07±4.3(21.4)	21.91±3.6(16.5)	26.1±0.9(3.45)	20.85±3.4(16.4)
Turbidity	39±10.6(27.1)	20.25±2.06(10)	52.5±6.5(12.39)	38±12.7(33.5)	21.5±2.08(9.7)	50.75±6.5(12.7)
Hardness	134.47±27.9(20.7)	105.67±11.5(11)	119.95±19.1(15.9)	124.85±20.3(16.3)	79.67±16.6(20.8)	128.31±89.9(70)
Calcium	34.47±7.5(23)	22.05±5.1(23.5)	23.79±1.28(5.4)	42.97±5.9(13.7)	24.47±1.13(4.6)	26.68±3.27(12.6)
Magnesium	68.29±6.5(9.51)	49.7±6.3(12.68)	59.54±9.65(16.2)	68.24±6.04(8.9)	32.04±10.97(34)	52.03±42.6(81.8)
CO_2	40.08±10.4(26)	23.28±9.7(41.6)	35.38±5.4(15.4)	69.3±24.9(35.96)	49.19±13.4(27.3)	62.46±10.5(16.9)
DO	8.39±1.44(17.2)	8.79±2.9(33)	7.66±1.6(20.9)	8.18±1.57(19.2)	9.98±0.94(9.4)	8.5± 1.5(17.6)
Alkalinity	249.26±21.2(8.5)	229.47±53.2(23)	174.23±63(36.2)	275.95±36.7(13.3)	244.63±55.8(22.8)	255.1±40.1(15.7)
Chloride	153.48±39.6(25.8)	92.16±25.8(28)	107.7±20.3(18.8)	104.69±12.9(12.3)	88.71±7.6(8.6)	97.7±22.8(23.4)
PO_4	0.48±0.16(32.5)	0.54±0.16(30)	0.43±0.05(10.8)	0.44±0.05(11.36)	0.49±0.13(26.5)	0.48±0.06(12.1)
SO_4	43.71±15.3(35)	42.87±14.7(34)	28.7±5.7(19.7)	42.08±8.6(20.5)	38.66±7.9(20.5)	29.21±6.9(23.6)
BOD	2.35± 0.63(26.9)	2.09±0.4(19.2)	1.71±0.48(28.1)	5.21±2.62(50.3)	3.2±0.78(24.4)	2.35±0.63(26.9)
Productivity						
NPP	2.045±0.30(14.7)	1.99±0.99(49.75)	1.877±0.30(15.98)	3.83±2.49(65)	3.06±1.39(45.4)	2.07±0.17(8.2)
GPP	1.32±0.13(9.85)	1.657±0.24(14.45)	1.28±0.13(10.16)	2.75±0.81(29.5)	3.37±1.39(41.24)	1.45±0.68(46.9)

Temperature shows positive correlation with chloride concentration and negative correlation with turbidity, hardness and magnesium (Table 2 & 3). Whereas hardness is positively correlated with magnesium, dissolved oxygen, phosphate, alkalinity and sulphate, negatively correlated with chloride and BOD. Calcium shows positive correlation with carbon dioxide and negative with GPP, chloride and phosphate. Magnesium is positively correlated with carbon dioxide, dissolved oxygen, phosphate and alkalinity whereas negatively correlated with chloride. Carbon dioxide is positively correlated with alkalinity and negatively correlated with GPP, chloride and BOD. Dissolved oxygen is positively correlated with phosphate and negatively correlated with sulphate. GPP shows positive correlation with chloride whereas NPP do not show correlation with any parameters in the present data. Alkalinity shows positive correlation with phosphate and sulphate whereas negative with chloride and BOD. Chloride is positively correlated with BOD whereas phosphate is positively correlated with sulphate and BOD.

Table 2

Correlation coefficient of various physico-chemical parameters at Prayagtirth during 2010 to 2011

Parameters	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	1.00	**-1.00**	0.87	-0.67	0.91	-0.78	0.92	0.14	0.82	0.61	0.84	0.76	0.71	-0.34

B		1.00	-0.84	-0.22	-0.88	0.82	-0.90	-0.08	-0.86	-0.56	-0.87	-0.71	-0.66	0.40
C			1.00	-0.22	**1.00**	-0.38	**0.99**	0.61	0.44	0.92	0.46	**0.98**	**0.96**	0.16
D				1.00	-0.31	**0.99**	-0.33	0.64	**-0.97**	0.18	**-0.97**	-0.02	0.05	0.93
E					1.00	-0.46	**1.00**	0.54	0.51	0.88	0.54	**0.96**	0.94	0.08
F						1.00	-0.49	0.50	**-1.00**	0.01	**-1.00**	-0.19	-0.12	0.85
G							1.00	0.51	0.54	0.87	0.56	**0.95**	0.93	0.05
H								1.00	-0.45	0.87	-0.42	0.76	0.80	0.88
I									1.00	0.05	**1.00**	0.25	0.18	-0.82
J										1.00	0.08	**0.98**	**0.99**	0.54
K											1.00	0.27	0.21	-0.80
L												1.00	**1.00**	0.36
M													1.00	0.42
N														1.00

Where, the values between 0.95 to 0.98 is significant at p=0.05% and 0.99 and above is significant at p= 0.01%

A= Water Temperature; **B**= Turbidity; **C**= Hardness; **D**= Calcium; **E**= Magnesium; **F**= Carbon dioxide; **G**= Dissolved oxygen; **H** = NPP; **I**= GPP; **J**= Alkalinity; **K**= Chloride; **L**= Phosphate; **M**= Sulphate; **N**= BOD

Table 3

Correlation coefficient of various physico-chemical parameters at Prayagtirth during 2011 to 2012

Parameters	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	1.00	**-0.94**	**-0.99**	-0.64	**-1.00**	-0.94	-0.49	0.02	0.48	-0.94	**0.98**	0.78	0.53	0.90
B		1.00	0.89	0.73	0.93	0.78	0.75	-0.35	-0.16	0.78	-0.87	-0.52	-0.78	-0.70
C			1.00	0.73	**1.00**	**0.98**	0.37	0.11	-0.60	**0.98**	**-1.00**	-0.85	-0.41	**-0.95**
D				1.00	0.67	0.86	-0.36	0.76	**-0.98**	0.85	-0.77	**-0.98**	0.32	-0.91
E					1.00	**0.96**	0.46	0.02	-0.52	**0.96**	**-0.99**	-0.80	-0.50	-0.91
F						1.00	0.17	0.32	-0.75	**1.00**	**-0.99**	-0.94	-0.22	**-0.99**
G							1.00	-0.88	0.52	0.18	-0.33	0.17	**-1.00**	-0.06
H								1.00	-0.87	0.31	-0.16	-0.61	0.86	-0.42
I									1.00	-0.74	0.63	0.93	-0.49	0.82
J										1.00	**-0.99**	-0.94	-0.22	**-0.99**
K											1.00	0.88	0.37	**0.96**

L												1.00	-0.12	**0.97**
M													1.00	0.10
N														1.00

Where, the values between 0.95 to 0.98 is significant at p=0.05% and 0.99 and above is significant at p= 0.01%
A= Water Temperature; **B** = Turbidity; **C**= Hardness; **D**= Calcium; **E** = Magnesium; **F**= Carbon dioxide; **G**= Dissolved oxygen; **H** = NPP; **I**= GPP; **J**= Alkalinity; **K**= Chloride; **L**= Phosphate; **M**= Sulphate; **N**= BOD

5. CONCLUSION

During two years of monitoring we come to the conclusion that, as day by day different activities performed at the sites, force of pollution exerted at the site is not same for every day. As intensity stressed on water body is different for different days, its not possible to get same concentrations of physico-chemical parameters during same seasons of consecutive years. Addition or deletion (utilization) of a small thing can cause a big change in any ecosystem because all these parameters, animals and plants are interlinked together.

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